

**71 SERIES
OSCILLOSCOPE
DISPLAY UNIT
7100**



DYNAMCO

CHERTSEY · SURREY · ENGLAND

Telephone: Chertsey 2636 Telex: 263387 Cables: Dynamco Chertsey



Issue 3 Sept. 1969

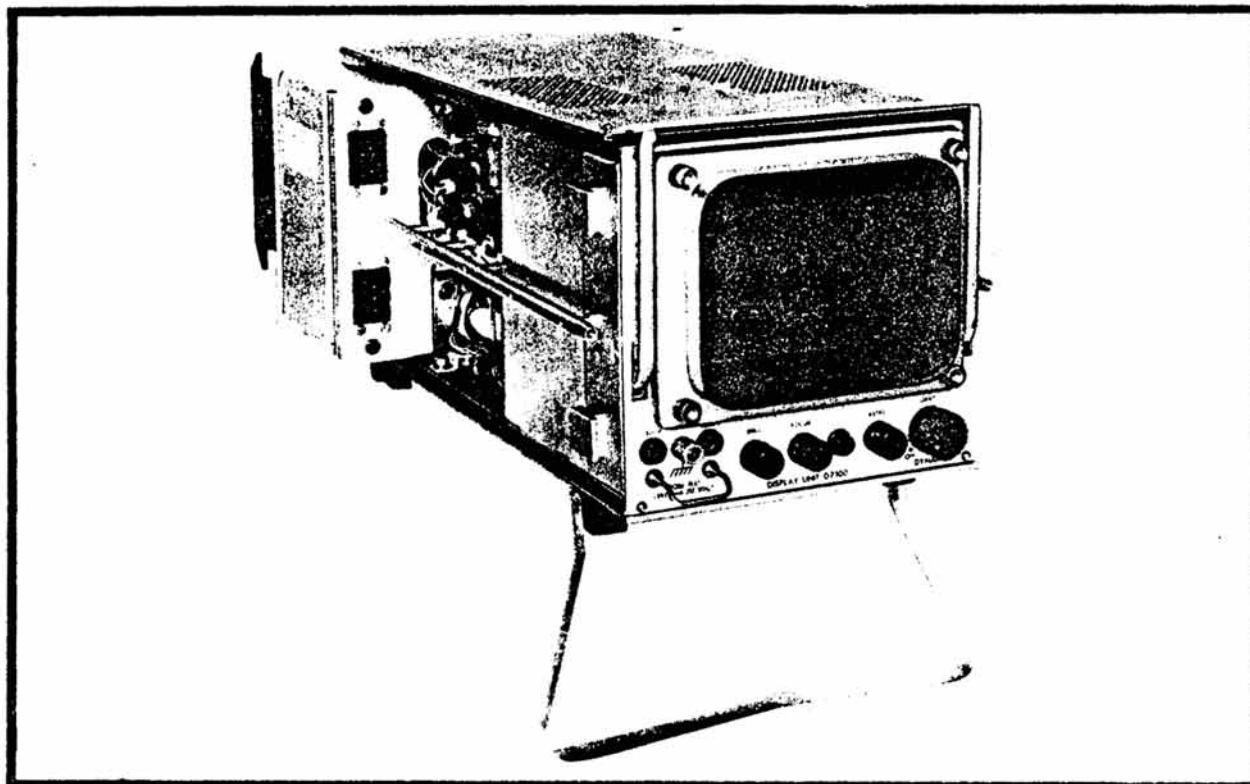
7100

OSCILLOSCOPE 10KV DISPLAY UNIT

£ 350 + VAT. 1/78

Dual trace }
Delayed T.B. }

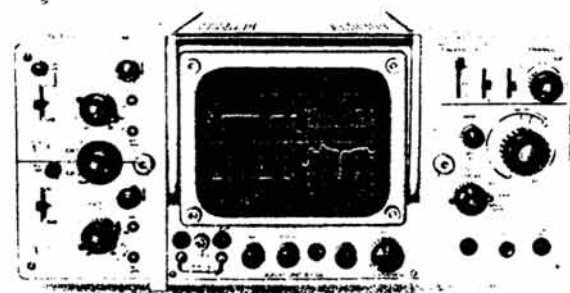
- ☐ 10KV EHT for high writing speeds
- ☐ Unique modular construction providing great versatility
- ☐ Horizontal and vertical plug on units interchangeable for XY displays
- ☐ Display unit may be used separately for monitor purposes
- ☐ Silicon transistors used throughout
- ☐ Suitcase proportions and low weight for field use



The 7100 Display Unit contains the cathode ray tube and controls, power supplies, calibrator, vertical and horizontal main deflection amplifiers and unblanking amplifier for the 71 series of oscilloscopes.

On to either side of the Display Unit may be plugged the vertical and horizontal deflection units.

The design of the 7100 display unit allows its use as a self contained oscilloscope with or without plug-on units. Metalwork is available (X701) for customers who wish to make their own plug-on units.



Display

Cathode Ray Tube: 5in (12.7 cm) rectangular face plate, mesh screened PDA.

Spot Size: 0.4 mm nominal.

Phosphors: P31 (GH) as standard. Others including P2 (GP), P7 (GM) and P11 (BE) available to special order.

Graticule: External, 10cm by 6cm in centimeter divisions with 2mm subdivisions on major axes. Internal graticule available as an optional extra.

Illumination: Edge Lit, variable intensity.

Accelerating Voltage: Approximately 10KV overall.

Unblanking: D.C. coupled to CRT Grid.

External Z Modulation: D.C. coupled via unblanking amplifier.

Input Resistance: 10K Ω .

Input Voltage: 10V gives noticeable modulation at normal brilliance levels.

Frequency Response: DC to 5MHz -3dB.

Calibrator

Waveform: Approximately Squarewave.

Markspace Ratio: 1 : 1 $\pm$ 10%.

Polarity: Positive going. Baseline at zero volts.

Amplitudes: 50mV, 500mV and 5V.

Accuracy: $\pm$ 2%.

Repetition Rate: 1KHz $\pm$ 2%.

Rise Time: $< 1 \mu$ s.

Fall Times: $< 5 \mu$ s.

Output Impedance: 50mV, 500mV : 50 Ω .
5V: 500 Ω .

Current Output: 10mA 1KHz squarewave available at loop on front panel, $\pm$ 2%.

DYNAMCO

A DIVISION OF DYNAMICS CORPORATION OF AMERICA

Broxburn West Lothian Scotland • Telephone Broxburn 2631 Telex 72174

Use of Display Unit without Standard Plug-on Units

The following information is provided so that the correct interface can be obtained.

Deflection Signals: The amplifiers in the Display Unit are arranged to equalize the input sensitivities on the X and Y axes. The sensitivities are factory set to 100mV/cm push-pull, i.e. 200mV/cm for unbalanced (single ended) drives.

The linearity of the X and Y amplifiers is maintained for 6 x 6 cm displays if driven unbalanced, larger displays need a balanced drive.

The amplifiers should be driven, direct coupled, from a low impedance source (50-100 Ω) with a mean level of 0V. To avoid possible damage to the input transistors signals must not exceed 4V peak-to-peak, and limiting devices may be required in some applications.

Vertical Bandwidth: D.C. to $> 65\text{MHz}$ -3dB from 50 Ω source at 5cm deflection.

Horizontal Bandwidth: D.C. to 5MHz -3dB from 50 Ω source at 8cm deflection (capable of displaying 20ns/division linear sweep).

Brightness Modulation: (A) For relatively high voltages use EXT Z socket. A 75V negative going (from 0V) pulse will fully brighten the trace and 10V will cause noticeable modulation.

(B) For lower voltages direct connection may be made via the display unit plug-on connections to the bright-up amplifier. The total maximum current drive for full brightness is -7.5 mA.

Power Supplies Available: The display unit plug-on connectors carry the following supplies:-

-15V	350mA	500mA total.
+15V	350mA	
+20V unregulated	150mA	
+117V	70mA	
6.3V r.m.s.	700mA r.m.s.	

Power Requirements

Voltage: 95 - 125V a.c. and 190 - 255V a.c.

Frequency: 50 - 60Hz and 400Hz Nominal.

Consumption: 20 - 80 VA depending upon plug-on units used.

Regulation: All supplies are stabilized and proof against accidental short circuit.

Camera Fixing

Standardized: Horizontal centres $4\frac{7}{8}$ in. (12.4 cm).
Vertical centres: $3\frac{3}{4}$ in. (9.55 cm).

Rack Mounting

A rack-mounting kit is available for all combinations of plug-on modules, so that the oscilloscopes can be fitted in standard 19in. racks. Height in rack mount: 7in. (17.8cm).

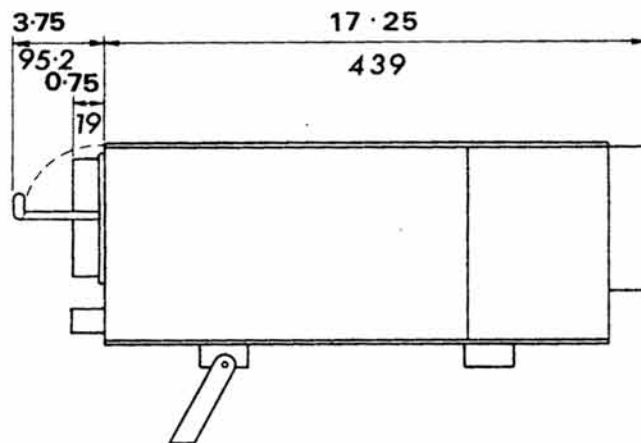
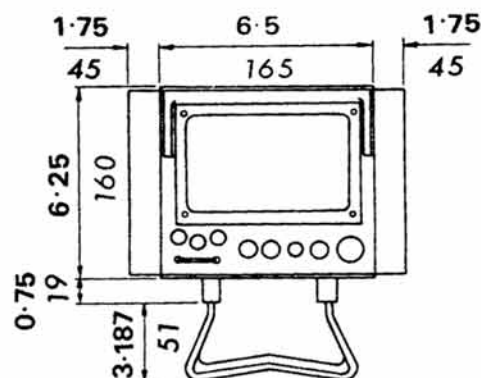
Weight

Less plug-on modules 19lb (8.7 Kg).

Typical size and weight of an operational oscilloscope with Vertical Deflection Module 1Y2 and Sweep Generator Module 1X1 plugged on to Display Unit.

Size: Front Panel: $6\frac{1}{2}$ in. (16.5cm) high.
 $13\frac{3}{4}$ in. (35cm) wide.
16 in. (40.6cm) depth.

Weight: 30 $\frac{1}{2}$ lb (14Kg).



Dimensions in Inches

Dimensions in Millimetres

Accessories

A full range of accessories is available and details are given on the Accessory data sheet.

AMENDMENT SHEET

Instrument	Issue No.	Amendment	Date Raised
7100	3	A	October 1969

Page	Section	Para.	Fig.	Details of Change
16	4.3	5		The following components are deleted from the X-Amplifier board: 2C6, 2C7, 2R17, 2R21, 2D1, 2D2
28	6.4			
			8	
			9	2D1 and 2D2 are replaced by wire links.

CONTENTS

<u>Section</u>		<u>Page No.</u>
1	INTRODUCTION	1
2	SPECIFICATION	3
3	OPERATION	5
	3.1 General	5
	3.2 Power Supply Connections	5
	3.3 Interconnections	6
	3.4 Control Functions	9
	3.5 Initial Calibration	9
	3.6 Display Unit Operation	11
	3.7 Use of the Display Unit without Standard Modules	11
4	TECHNICAL DESCRIPTION	13
	4.1 Mechanical Features	13
	4.2 Functional Description	13
	4.3 Circuit Description	14
5	MAINTENANCE	17
	5.1 Mechanical Features	17
	Removal of Cover	17
	Removal of Cathode Ray Tube	17
	Amp Connectors	17
	Access to E.H.T. Box	18
	Plug-In Semiconductors	18
	5.2 Setting-Up Instructions	18
	Equipment Required	19
	Preliminary Checks	19
	Power Supplies	19
	Tube Electrode Potentials	20
	Calibrator	20
	X Amplifier Bias	20
	X Amplifier Gain	21
	Y Amplifier Balance	21
	Y Amplifier Gain	21
	Gun Alignment	21
	Trace Alignment	21
	Calibrator Frequency Setting	21
	Scanning Direction and Y Deflection Direction	22
	X Amplifier H.F. Linearity	22
	Bright-Up Check	22
	Blanking Check	23
	Y Amplifier Response Check	23
	Bandwidth Check	24
	Internal Link Continuity Check	24
	5.3 Maintenance by Dynamco	24

SectionPage No.

6	PARTS LIST	25
6.1	General	25
6.2	Chassis Components	25
6.3	Y Amplifier and Calibrator	26
6.4	X Amplifier	27
6.5	Power Supply Card	29
6.6	EHT Regulator Card	30
6.7	EHT Rectifier Card	31
6.8	Bright-Up Card	32
6.9	Accessories (Optional)	33

ILLUSTRATIONS

FigurePage No.

1	Display Unit 7100 - General View	1
2	Display Unit 7100 - Dimensions	2
3	Display Unit 7100 - Rear View	7
4	Display Unit 7100 - Controls	8
5	Display Unit 7100 - Block Diagram	following text
6	Dummy Load	following text
7	Input Adaptor	following text
8	Display Unit 7100 - Circuit	following text
9	Component Location 1	following text
10	Component Location 2	following text
11	Chassis Interconnections	following text

TABLES

TablePage No.

1	Power Supplies	5
2	Supply Connections to Modules	7
3	Signal Connections to Modules	7
4	Control Functions	9
5	Plug-In Semiconductor Information	18
6	Power Rail Resistance	19
7	Power Supply Tolerances	20

1. INTRODUCTION

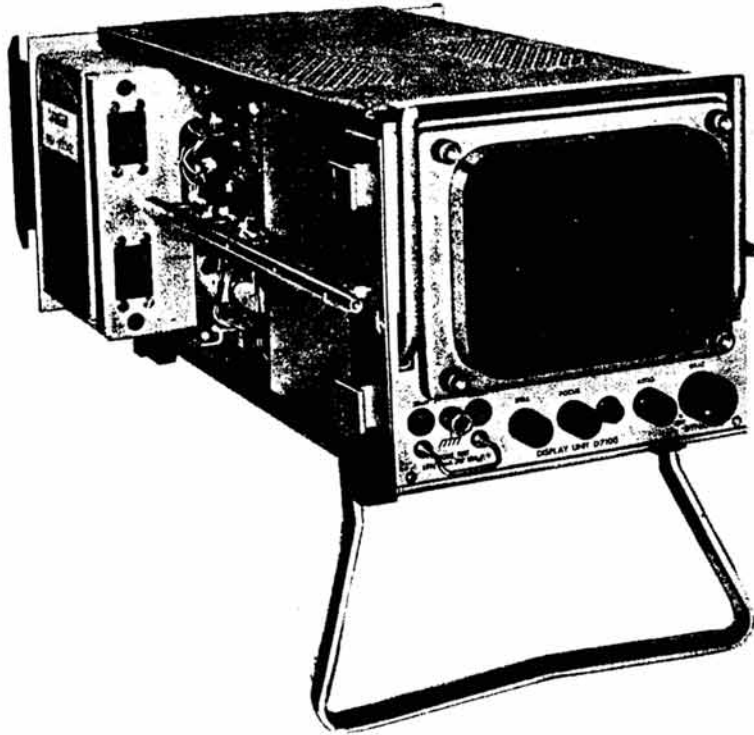


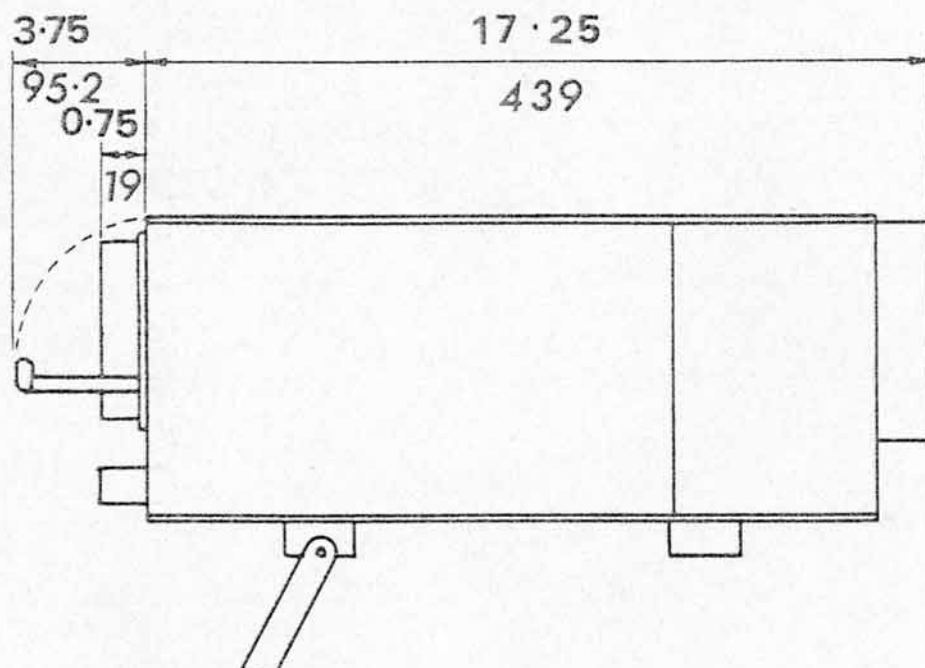
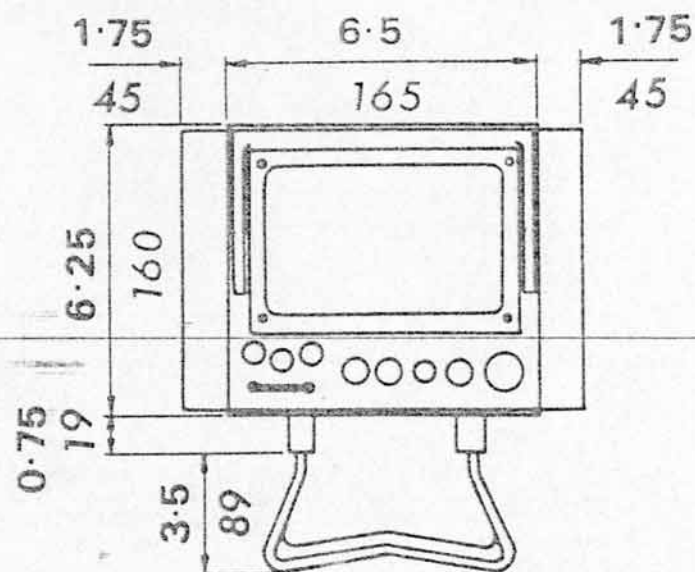
Fig. 1. Display Unit 7100 - General View

The Display Unit 7100 is the central unit of the Dynamco 71 Series oscilloscope. It contains the cathode ray tube and controls, power supplies, calibrator, vertical and horizontal deflection amplifiers and the bright-up amplifier. The timebase and Y-amplifier modules plug on to either side of the display unit.

The 5 inch (6 cm x 10 cm display) mesh screened p.d.a. cathode ray tube operates at 10KV, giving sharp, crisp displays with a brightness consistent with the bandwidth thus ensuring strain free viewing under high ambient illumination. Camera fixing centres are standard, and alternative phosphors are available.

The Display Unit may be used for X-Y displays, by plugging vertical deflection modules on each side.

The Display Unit may also be used without plug on modules for displaying signals generated by other equipment.



DIMENSIONS IN INCHES
DIMENSIONS IN MILLIMETRES

WEIGHT 19.5 LB
8.8 KG

FIG.2 DISPLAY UNIT 7100-DIMENSIONS

2. SPECIFICATION

2.1 DISPLAY

CATHODE RAY TUBE	5 in. (12.7 cm) rectangular face plate, mesh screened P.D.A. <i>D13-51 Brimar</i>
SPOT SIZE	0.4 mm nominal. <i>1300 Q GEC/MOV</i>
PHOSPHORS	P31 as standard. Others, including P2, P7 and P11 available.
GRATICULE	External, 10 divs. by 6 divs. in cm divisions with 2 mm subdivisions on major axes.
ILLUMINATION	Edge lit, variable intensity.
ACCELERATING VOLTAGE	Approximately 10KV overall.
UNBLANKING	D.C. coupled to CRT grid.
EXTERNAL Z MODULATION	D.C. coupled via unblanking amplifier. Input Resistance: 10K Ω Input Voltage: 5V gives noticeable modulation at normal brilliance.
OPERATING TEMPERATURE (AMBIENT)	0 to 50°C maximum. Note that in a rack, temperatures may rise appreciably above ambient.

2.2 CALIBRATOR

WAVEFORM	Approximately square.
POLARITY	Positive going from baseline at zero volts.
AMPLITUDES	50mV, 500mV and 5V
ACCURACY	$\pm 2\%$
REPETITION RATE	1KHz $\pm 2\%$
RISE TIME	Not greater than 1 μ s
FALL TIME	Not greater than 5 μ s

OUTPUT IMPEDANCE	50mV, 500mV - 50 Ω , 5V - 333 Ω
CURRENT OUTPUT	10mA, 1KHz squarewave available at loop on front panel, $\pm 2\%$.

2.3 POWER REQUIREMENTS

VOLTAGE	95 - 125V a.c. and 190 - 257V a.c.
FREQUENCY	50 - 60Hz and 400Hz nominal.
CONSUMPTION	60 - 70VA depending upon plug-on units used.
REGULATION	All supplies are stabilized and proof against short term overloads.

2.4 CAMERA FIXING

STANDARDIZED	Horizontal centres 4.7/8 ins. (12.4 cm). Vertical centres 3 $\frac{3}{4}$ in. (9.55 cm).
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2.5 VERTICAL DEFLECTION SYSTEM

Balanced amplifier driving CRT Y plates.

SENSITIVITY	200mV/division.
BANDWIDTH	D.C. to 65MHz -3dB approx. when driven from 50 Ω source at 5 cm deflection.

2.6 HORIZONTAL DEFLECTION SYSTEM

Balanced amplifier driving CRT X plates.

SENSITIVITY	200mV/division.
BANDWIDTH	D.C. to 5MHz -3dB approx. when driven from 50 Ω source, at 8 divs. deflection (capable of displaying 20ns/division linear sweep).

NOTE: Horizontal and vertical main deflection amplifier input sensitivities have been equalized. This enables a vertical deflection plug-on unit to be fitted to the horizontal position for XY plotting facilities.

3. OPERATION

3.1 GENERAL

These instructions should be read through carefully before attempting to use the instrument.

Ventilation: The instrument may be operated in almost any attitude without over-heating. It is, however, recommended that the instrument is not used for more than two consecutive hours when stood on its rear face. Always ensure that the ventilation holes in the top and bottom of the Display Unit are unobstructed.

Plug-On Modules: X and Y plug-on modules may be removed from the Display Unit (bench or rack mounted) by unscrewing the knurled, slotted screw on the inner edge of the plug-on. Hold the Display Unit with one hand and slide the Plug-On Module forward with the other hand until the guide and guide rail disengage. Fitting is the opposite to removal. Always ensure that the module is fully engaged and slotted screw is tight. Switch off supplies when changing modules.

A fold-away support stand, mounted beneath the Display Unit may be used to provide the optimum angle of viewing for bench operation.

Rack Mounting: Bench mounted instruments may be readily adapted for rack mounting. Remove the feet and lower cover. Slide the instrument into the rack mounting accessory, locate and secure from beneath using four screws. Fit blanking panels as required.

Carrying Handle: A carrying handle is fitted to the Display Unit and is unobtrusively hinged round the upper part of the c.r.t. escutcheon when not in use.

3.2 POWER SUPPLY CONNECTIONS

Four operating voltage ranges are available, 95-113V a.c., 110-125V a.c., 190-225V a.c. and 220-257V a.c.

The required range is selected internally at the power transformer tapplings (117V and 234V nominal) and switched externally by means of a HIGH/LOW switch at the rear of the Display Unit. Details of power supplies are shown in Table 1.

TABLE 1. POWER SUPPLIES

Power Transformer Tappings	Rear Switch Position	
	LOW	HIGH
234V	190-225V	220-257V
117V	95-113V	110-125V

The instrument is despatched from the factory with the power supply transformer tapings at 234V and the range switch set to HIGH (220-257V).

To change the transformer tapping to the 117V range, remove the right hand module and the lower cover on the Display Unit. Remove the lead from transformer pin 71 and solder it to the transformer side of fuse FS1. Fit an insulated wire link between transformer pins 71 and 60.

The HIGH/LOW switch position is locked by a retaining plate secured to the chassis with two screws. To change the switch position, remove the plate and operate the switch, reverse and refit the plate. Each side of the retaining plate is appropriately engraved to show which part of the nominal range (set internally) has been selected.

NOTE: Always ensure that the HIGH/LOW switch is at the correct setting. If HIGH is selected with a low supply voltage, calibration accuracy will be lost and excessive ripple seen on the trace. If LOW is selected with a high voltage, excessive power will be dissipated in the oscilloscope.

Always check that the correct a.c. fuse is fitted, 1A for 95-125V a.c. and 500mA for 190-247V a.c., both slow-blow types.

A power supplies cable is provided with each instrument and must be connected to the supply as follows :-

<u>Colour Code</u>		<u>Supply</u>
RED	BROWN	LINE
BLACK	OR LIGHT BLUE	NEUTRAL
GREEN	YELLOW/GREEN	EARTH

3.3 INTERCONNECTIONS

Connections to the timebase module are made via two 12-pole fixed sockets SKTA and SKTB (see Fig. 3) and connections to the Y-amplifier module are made via similar sockets SKTC and SKTD. These connections are made automatically when the modules are plugged on the display unit. The services on these sockets are listed in Tables 2 and 3 (see also Fig. 11).

The Z MOD and EARTH sockets on the rear panel enable the user to apply a modulating signal to the c.r.t. grid. When a timebase unit is connected, +75 V will cause full blanking. When the display unit is used on its own, 7.5mA negative at SKTB/4 or SKTC/4 (375mV negative going from earth) will cause maximum positive drive to the c.r.t. grid, i.e. maximum brilliance.

TABLE 2. SUPPLY CONNECTIONS TO MODULES

Bulkhead Sockets SKTA, SKTD Pin Number	Function	Total (X+Y) Current Availability
1	+117V	70mA
2	-	-
3	+30V Unstab	150mA
4	+20V Unstab	150mA
5	+ 15V	450mA
6	- 0V	-
7	6.3V a.c. Earthy	0.7A
8	6.3V a.c. Live	
9	- 15V	450mA
10	+Trig)	
11	Earth)	
12	-Trig)	

TABLE 3. SIGNAL CONNECTIONS TO MODULES

Bulkhead Sockets SKTB, SKTC Pin Number	Function	Remarks
1	+ Amplifier Input)	200mV/cm
2	Earth)	
3	- Amplifier Input)	7.5mA, negative
4	Bright Up Command - Live	
5	Display Gate)	
6	Earth)	
7	Alternate to Display Gate	
8	Bright Up Command - Earth	
9	-	
10	-	
11	Spare Link - Live	
12	Spare Link Screen - Earth	

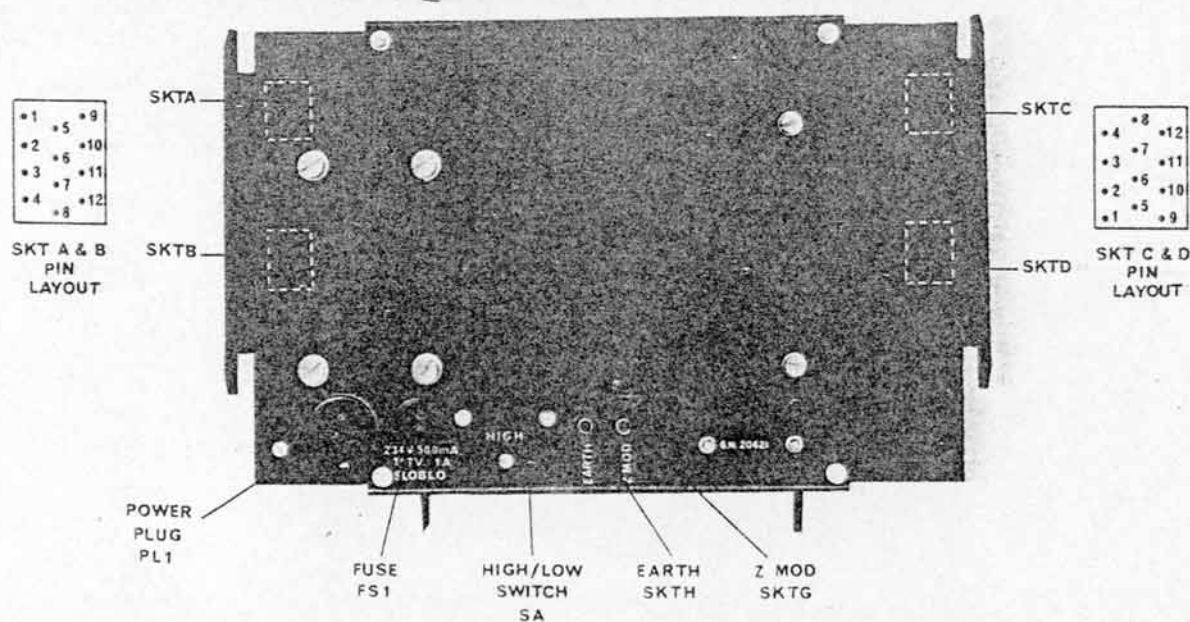


Fig. 3. Display Unit 7100 - Rear View

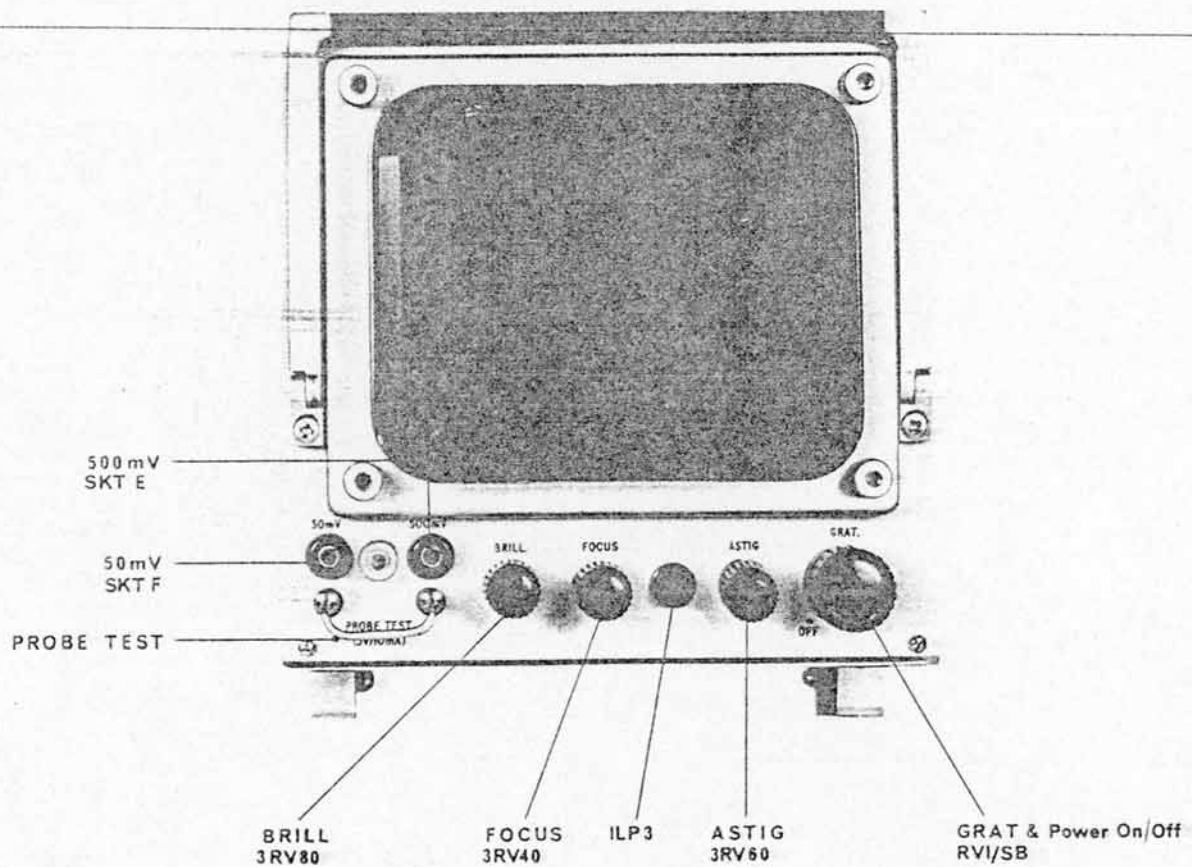


FIG.4 DISPLAY UNIT 7100 - CONTROLS

3.4 CONTROL FUNCTIONS

Figure 4 shows the location of the front panel controls and details of their functions are given in Table 4.

TABLE 4. CONTROL FUNCTIONS

CONTROL	FUNCTION -
GRAT	This controls the graticule illumination intensity. It is also ganged with the power on/off switch. Progressive clockwise rotation increases the light intensity. A glowing red neon indicates power on.
ASTIG	Provides adjustment of the c.r.t. spot shape.
FOCUS	Provides adjustment to give the smallest spot or finest trace.
BRILL	This varies the brightness of the c.r.t. display
50mV, 500mV Sockets	Calibrator outlet sockets carry 50mV peak-to-peak and 500mV peak-to-peak 1KHz square wave voltages for calibration of the X and Y axes and probe setting.
PROBE TEST (5V/10mA) Loop	The PROBE TEST loop carries 10mA and also 5V 1KHz square wave for probe setting or calibration.

3.5 INITIAL CALIBRATION

The following instructions assume that the Display Unit 7100 is fitted with a Dual Channel Amplifier 1Y2 and a Delayed Sweep Timebase 1X2 since this combination covers the greatest number of facilities offered by the system at present. If other modules are used (1X1, 1Y1, 1X6, 1Y7) omit non-applicable procedures.

- (1) Check that the power transformer tapping and HIGH/LOW switch at the rear of the Display Unit are correctly set for the power supplies.
- (2) Ensure that the correct fuse is fitted. 1A for 95-125V a.c., 500mA for 190-257V a.c., both slow-blow.
- (3) On the Display Unit set the controls to their midway positions.
- (4) On the Y Module set the controls as follows:-

VOLTS/DIV	to 10mV/div
VARIABLE	to CAL (fully clockwise)
AC, DC, GND	to AC

PULL X10	to	IN	
Shift	to	Midway	
Mode	to	CH1	)
Trigger	to	CH1 TRIG	) 1Y2 only
PULL INV	to	IN	)

- (5) On the X Module set the controls as follows :-

Source INT, EXT, EXT $\div$ 20	to	INT
Coupling DC EXT ONLY, AC, ACF	to	AC
Slope SYNC, +, -	to	+
HF STAB	to	AUTO (fully anti-clockwise)
LEVEL	to	Midway
TIME/DIV	to	1mS
VAR	to	CAL (fully clockwise)
PULL X10	to	IN
DISPLAY	to	(NORMAL DISPLAY 1X1 A SWEEP DISPLAY 1X2

DELAY SWEEP-B (1X2 Only)

DELAY TIME MULT	to	5
TIME/DIV	to	1ms
CAL	to	Fully clockwise

- (6) Connect a short, screened jumper lead between the 50mV socket on the Display Unit and channel 1 input socket on the Y Module.
- (7) Switch on with the GRAT control and check that the red supply lamp glows. Adjust BRILL, FOCUS and ASTIG controls on the Display Unit to give the best trace. Adjust GRAT control to provide required graticule illumination level.

NOTE: The instrument may be used as soon as the trace appears, but full measuring accuracy may not be realized. If after 15 minutes it is necessary to check calibration, proceed as follows :-

- (8) Adjust the screwdriver preset control BAL on CH1 of the Y Module so that minimum trace shift occurs when the VARIABLE gain control is changed, with the input switched to GND.
- (9) Set the AC, DC, GND control on the Y Module to AC.
- (10) Adjust the screwdriver preset control SET GAIN on CH1 of the Y Module for an exact peak-to-peak trace of 5 divisions.
- (11) Connect the jumper lead to the CH2 input socket on the Y Module. Set the mode switch to CH2 and the trigger switch to CH2.TRIG and repeat steps (7) to (10) for channel 2 BAL and SET GAIN adjustments.
- (12) Check that the trace is locked. If not, adjust the LEVEL control.
- (13) Set the VARIABLE control to the CAL (fully clockwise) position on the X Module.

- (14) Adjust the SET CAL preset control on the X Module so that the display shows exactly 1 cycle/division.

NOTE: If the trace is not parallel with the graticule, slide back the top cover of the Display Unit, and adjust 2RV50 on the X amplifier card on the right hand side. On some models the trace rotate control 2RV50 is located on the front panel behind the handle to the right of the c.r.t.

THE OSCILLOSCOPE IS NOW CALIBRATED AND READY FOR SERVICE.

3.6 DISPLAY UNIT OPERATION

- (1) Ensure that selected voltage range and fuse rating suits the power supplies to be used.
- (2) Switch on GRAT control (clockwise) and ensure red supply lamp glows.
- (3) Adjust GRAT control to suit graticule illumination requirements.
- (4) Adjust FOCUS, ASTIG and BRILL controls as required.

3.7 USE OF THE DISPLAY UNIT WITHOUT STANDARD MODULES

The 71 Series Display Unit may be used as a self contained oscilloscope with or without plug-on modules. Metalwork is available (7141) for customers who wish to make their own X and/or Y plug-on modules.

(1) Power Supplies Available

The Display Unit plug-on connections carry the following supplies :-

SKTS A, D Pin Number	SUPPLY	MAX. CURRENT
9	-15V	350mA
5	+15V	350mA)
4	+20V unreg.	150mA) 500mA total
1	+117V	70mA
7, 8	6.3V rms.	700mA (pin 7 to chassis)

THE MAXIMUM CURRENTS QUOTED MUST NOT BE EXCEEDED AND ARE THE TOTAL AVAILABLE FOR BOTH MODULES, i.e. if a Y module is fitted its current requirements must be subtracted from the total, the remainder being available for the X module. The supplies are protected against short term overloads, but long term overloads will, in some cases, require the replacement of a small protective resistor in the power supply.

(2) Deflection Signals

The amplifiers in the Display Unit are arranged to equalize the input sensitivities on the X and Y axes to 200mV/div. Good linearity of the X and Y amplifiers is maintained for 6 x 6 div. displays if driven unbalanced, but larger displays may need a balanced drive.

The amplifiers should be driven, direct coupled, from a low impedance source (50 - 100 Ω) with a mean level of 0V. To avoid possible damage to the input transistors, signals must not exceed 4V peak-to-peak, and limiting devices may be required in some applications.

(3) Brightness Modulation

The Z MOD socket on the rear of the Display Unit should be used in applications where a relatively high voltage is available. A 75V negative going (from 0V) pulse will fully brighten the trace. Voltages in excess of this will cause saturation of the bright-up amplifier and consequent loss of response time.

In applications where less voltage drive is available connection to the bright up amplifier should be made via pin 4 on either X SKT B or Y SKT C. These inputs require a maximum current drive of -7.5mA (e.g. a 2K Ω resistor to -15V) and care should be taken to limit the current to this figure, for the reason stated above.

NOTE: A low impedance drive should never be used.

4. TECHNICAL DESCRIPTION

4.1 - MECHANICAL FEATURES

The chassis of the Display Unit 7100 houses the cathode ray tube, the power supplies for the complete instrument, X and Y amplifiers, a bright-up amplifier, and a calibrator.

The main power supply board (coded 3) is beneath the tube, and the X and Y amplifiers are to the right and left respectively when the chassis is viewed from the top. At the rear of the tube on the left is an aluminium box containing the E.H.T. components. The power transformer T1 is to the right of the tube with the bright-up amplifier board (coded 6) mounted on top of it. The heat sink forming part of the back of the instrument holds the four regulator transistors (see Fig.9).

4.2 FUNCTIONAL DESCRIPTION (Fig. 5)

Power Supplies

The power supplies for the modules of the 71 Series Oscilloscope are derived from the power transformer T1. Outputs from the transformer are rectified to provide the 20V and 30V unstabilized supplies, and also rectified and regulated to provide the +117V, +63V, +15V and -15V stabilized supplies. Secondary windings on T1 also provide 6.3V a.c. for the c.r.t. heater and graticule lamps.

The e.h.t. supplies for the c.r.t. are derived from transformer T2, driven by a feedback oscillator. Outputs from T2 provide +9KV for the post deflection anode (p.d.a.), -957V d.c. for the c.r.t. cathode and also brilliance and focus control for the c.r.t., and a floating supply (approximately 1.5KV) for the c.r.t. grid.

Bright-Up Amplifier, X and Y Amplifiers, Calibrator

Inputs to the Bright-Up Amplifier are derived from the X module (bright-up), Y module (blanking) or externally (Z modulation). The amplifier mixes and amplifies the inputs and feeds the a.c. component of the bright-up pulse to the grid of the c.r.t. X and Y inputs from the plug-on modules are fed to horizontal and vertical amplifiers which drive the X and Y plates on the c.r.t.

The calibrator is an emitter coupled astable producing a 1KHz square wave. The calibrator provides 50mV, 500mV, 5V and 10mA peak-to-peak signals for calibration purposes.

4.3 CIRCUIT DESCRIPTION (Fig. 8)

Main Power Supply

The supply for the power transformer T1 comes from PL1 at the rear of the instrument to the ON/OFF switch SB. This switch is ganged to the graticule lighting control RV1. A link panel and switch SA are utilized to arrange the tapped primary windings of T1 so that the input voltage can be anything within the range 95V a.c. to 130V a.c. and 190V a.c. to 275V a.c. Lamp 1LP3 connected across one input winding indicates when the power is on. The instrument is protected by fuse FS1.

+30V (Unstabilized) Supply

The bridge rectifier 3D16/17/18/19 produces a nominal 30V which is smoothed by 3C10 and fed to the e.h.t. regulator board, and the rear sockets.

+117V Supply

The +117V supply is obtained from the bridge rectifier 3D12/13/14/15, smoothed by 3C1 and fed via a 100 Ω limiting resistor 3R20 to the series regulating circuit VT1, 3VT7 connected as a Darlington pair. Diode 3D21 provides reverse bias protection for VT1, 3VT7. Amplifier 3VT1 base circuit is fed with a potential set at the junction of 3R17, 3R18, summed with a feed forward potential set at the junction of 3R22, 3R23. The emitter is connected to the +15V supply. Resistors 3R17, 3R18 form a divider chain with 3RV2, between the output and -15V. 3RV2 sets the output voltage to +117V. Zener diode 3D22 keeps the current through 3VT1 substantially constant irrespective of supply changes. Resistor 3R26 and zener diode 3D23 provide current and voltage limiting for 3VT1.

+63V Supply

The +63V supply is obtained from bridge rectifier 3D8/9/10/11, and is smoothed by 3C2A, 3R28 and 3C2B. Reverse bias protection for the series regulator VT2 is by diode 3D20 and current and voltage limiting for 3VT2 is by resistor 3R27 and zener diode 3D26. The reference level is taken from the +15V and -15V supplies.

+15V Supply

Rectifiers 3D4/5/6/7 supply +20V nominal which is fed unregulated to the bulkhead sockets. Positive 20V is also fed to the series regulator VT3 to provide the +15V line. The reference level is obtained from the -15V supply and 0V.

-15V Supply

Bridge rectifier 3D1/2/3/4 provides 20V nominal which is smoothed by 3C4 before being fed to series regulator VT4. Transistor VT4 is controlled by 3VT5, 3VT6 which have their collectors supplied from the +15V. Zener diode 3D25 provides a reference voltage and the output is set by 3RV1. Zener diode 3D24 is used to start the circuit when it is first switched on.

6.3V A.C. Supply

One of the 6.3V windings supplies the graticule lamps and the bulkhead sockets. The other 6.3V winding supplies the heater of the c.r.t. and is insulated to withstand 2KV.

E.H.T. Supplies

The e.h.t. is produced from the secondaries of transformer T2, driven by the feedback oscillator VT5. The e.h.t. supplies are regulated by controlling the amount of feedback to VT5. This is achieved by sensing the change at the top end of the resistor chain 3R45, 3R46, 3R47, 3R48 and feeding this change to a directly coupled amplifier comprising 4VT1 and 4VT2.

Capacitor 4C2 and resistor 4R6 at the input of 4VT2 are phase correction components for the feedback control. Diodes 4D2 and 4D3 are reverse bias protection components. Diode 4D1 and capacitor 4C3 set the bias conditions of VT5 during oscillation.

The main secondary of T2 provides 3KV peak a.c. at 40KHz. This output is trebled by diodes 5D1/2/3, in conjunction with capacitors 5C2/3/4, and gives approximately +9KV d.c. This is fed to the post deflection anode, (p.d.a.) of the c.r.t. via 5R1. The main secondary is also tapped to provide a supply which is rectified by 5D6 and smoothed by 5C7, 5C1, producing -957V d.c. This voltage is fed to the cathode of the c.r.t. via 3R49 and 3R50. A portion of this voltage is fed to the focus anode of the c.r.t. via FOCUS control 3RV40 in parallel with 3R48, forming part of the divider chain.

The other secondary winding provides approximately 1.5KV which is rectified by 5D4 and smoothed by 5C5, 5R2, 5C6. The BRILL control 3RV80 connected in series with a divider chain across this supply feeds the grid of the c.r.t. The range of this control is set by 3RV81 which forms part of the divider chain. The d.c. component of the bright-up signal at the top of this floating winding is fed via 6R23, 6C11 on the bright-up board and is d.c. coupled to the grid of the tube via the winding, 5D4, 5R2, 3RV81, 3RV80, 6R25 and 6R26.

Bright-Up Amplifier

The bright-up amplifier has three inputs, bright-up gate, blanking, and ext. Z modulation. These are applied through resistors 6R3, 6R1 and 6R2 respectively, to the emitter of the grounded base mixer amplifier 6VT6. A mixed output is fed from the collector of 6VT6 to the base of emitter follower 6VT1, which feeds the amplifier 6VT2, via 6R8. 6VT2 feeds emitter follower 6VT3 which has a constant current sink 6VT4 and 6VT5 in its emitter circuit. Transistors 6VT4 and 6VT5 are turned on at the onset of the trailing edge of the bright up pulse via 6C6, and draw current from the stray capacitances of the circuit, dropping the trailing edge quickly by about 10V. Inductance 6L1, resistor 6R12 and capacitors 6C3, 6C4 decouple the supply line. The a.c. component of the bright-up pulse is fed to the grid of the c.r.t. via capacitor 6C14.

Y Amplifier and Calibrator

The Y amplifier and calibrator circuits are mounted on the same board. The Y amplifier consists of a long tailed pair 1VT5 and 1VT6 feeding the cascode circuits 1VT1/2/3/4. The inputs are fed via pins 50 and 51 through anti-parasitic resistors 1R3 and 1R14, to the bases of 1VT5 and 1VT6. The gain of the stage is set by three resistors, one of the resistors 1RV1 being preset. A pulse response circuit in parallel with this chain is adjustable by means of 1RV3 and 1C1. Balance control 1RV4 in the emitters of 1VT5 and 1VT6 is used to centre the spot on the screen (with no signal).

The outputs of the long tailed pair are fed to the bases of 1VT1 and 1VT4 through anti-parasitic resistors 1R28 and 1R12. The time constant networks between the emitters of 1VT1 and 1VT4 control the pulse response of the circuit. The collectors of 1VT2 and 1VT3 are fed from the 63V supply and are decoupled by capacitor 1C4. The outputs on pins 79 and 80 are fed directly to the Y plates of the c.r.t.

The calibrator is an emitter-coupled astable producing a 1KHz square wave output. The frequency can be set by adjusting 1RV50. The output from the generator is fed to the base of 1VT52 which switches the resistors 1RV51, 1R57, 1R58, 1R59 and 1R60 across the +15V line. Current through the chain can be adjusted by 1RV51 to produce the required voltage at sockets SKTE and SKTF and the current loop between pins 54 and 55. The decoupling capacitor 2C50 is located on the X amplifier board.

X Amplifier

This amplifier is similar to the Y amplifier, in that it comprises a long tailed pair 2VT5, 2VT6 and a pair of cascode circuits 2VT1/2, 2VT3/4. The inputs to the amplifier are on pins 43 and 44, through anti-parasitic resistors 2R1 and 2R7 to the bases of 2VT6 and 2VT5.

The balance of the long tailed pair is set by 2RV4 and the gain by 2RV1. The bases of transistors 2VT1 and 2VT4 are fed via anti-parasitic resistors 2R6 and 2R19. The bases of 2VT2 and 2VT3 are grounded. The outputs of the cascode stages feed the X plates of the c.r.t. via zener diodes 2D1 and 2D2 with capacitors 2C7 and 2C6 in parallel to obtain a mean plate potential of 50V preset by resistor 2RV2. The h.f. response on positive-going sweeps is improved by the addition of inductance 2L1. Capacitor 2C8 sets the h.f. response of the circuit for optimum linearity.

Cathode Ray Tube

The following adjustments are provided for the c.r.t. :-

- (1) GUN ALIGNMENT - 2RV61. Ensure that the beam passes centrally between the X plates.
- (2) GEOMETRY - 3RV62 adjusts the geometry. (Zener diode 3D60 maintains the electrode S3 at -25V relative to S2.)
- (3) ASTIG - 3RV60, is a front panel control and is used to adjust astigmatism.
- (4) TRACE ROTATE - 2RV50 adjusts current through a coil wound around the tube to align the trace with the graticule.

5. MAINTENANCE

5.1 MECHANICAL FEATURES

Removal of Cover

The module top cover is readily removed by unscrewing the four, chromé, round head screws on the top outer face of the cover.

Removal of Cathode Ray Tube

WARNING Before attempting to remove the tube check that the unit is disconnected from the power source by removing the power plug.

- (1) Disconnect side-pins, P.D.A. cap and remove base connector using loop provided. Access to the P.D.A. cap is accomplished by removal of the calibration screen panel on the left-hand side of the main frame. This panel is sprung into place and is removed, withdrawing the top first, by applying pressure to both sides in an outward direction.
- (2) Unscrew the four retaining nuts securing the escutcheon in position and remove the filter and graticule, taking care not to damage the graticule illumination lamps.
- (3) To withdraw the tube from the shield in the main frame it is recommended that a safety mask is worn over the face and gloves worn to protect the hands. Apply pressure to the base end of the tube to assist removal.
- (4) If a new tube is to be fitted the gun shield attached to the neck of the tube must be refitted to the new tube together with the foam rubber strips. Assembly is the reverse procedure to removal.

Amp Connectors

On some units connections to the circuit board are made via Amp type pin connectors. It is essential that when removing or inserting these connectors, the following precautions are observed.

- (1) Remove Amp pins by firmly grasping the crimped portion of the socket with a pair of square nosed or duck billed pliers and pulling the socket with an even force along the axis of the pin.
- (2) Fit Amp pins by firmly grasping the crimped portion of the socket with square nosed or duck billed pliers and pushing the socket squarely on to the pin with even pressure.
- (3) Making 'unsquare' connections can tend to open out the socket and result in a poor connection. This may cause intermittent operation of the instrument.
- (4) Any reconnections showing signs of looseness must be remade after the socket has been sufficiently closed up.

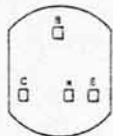
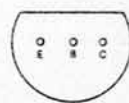
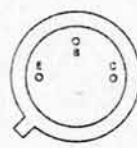
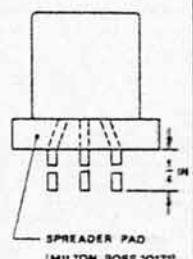
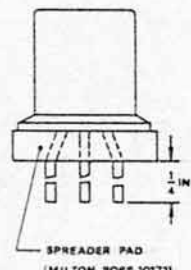
Access to E.H.T. Box

- (1) Remove top and bottom covers from instrument. Locate the e.h.t. box (see chassis layout illustration).
- (2) Remove the two cheese-head screws nearest the centre-line of the instrument on the top of the box, and the corresponding two screws from the bottom.
- (3) The e.h.t. box may now be lifted out to the extent permitted by the flying leads, giving access to 4RV1.
- (4) If further access is required, remove the four countersunk screws and remove the cover completely.

Plug-In Semiconductors

Transistors and tunnel diodes mounted on the boards are of plug-in type. When renewing plug-in semiconductors, the leads must be trimmed as in Table 5.

TABLE 5. PLUG-IN SEMICONDUCTOR INFORMATION

SOCKET CONNECTIONS	TO-92 PLASTIC PACKAGE	TO-18 METAL CASE PACKAGE
	VIEW ON LEADS	
 VIEWED FROM COMPONENT SIDE OF PRINTED CIRCUIT BOARD		
	TRIMMING LEADS	
* NOT USED	 SPREADER PAD (MILTON ROSS 10171)	 SPREADER PAD (MILTON ROSS 10171)

5.2 SETTING-UP INSTRUCTIONS

All internal potentiometers are set up at the factory, and should not be disturbed unless components are replaced or there is a definite indication that the unit is functioning incorrectly. Should this be the case the relevant potentiometer(s) should be set to the mid-position and then reset according to the following instructions, which constitute a complete performance check. Individual checks may, of course, be performed if required.

Equipment Required

- (1) Multimeter. AVO 8 or similar.
- (2) Dummy Load. See Figure 6.
- (3) Digital Voltmeter to measure from 50mV $\pm$ 1mV to 1KV $\pm$ 5V, e.g. Dynamco 2022.
- (4) Monitored Variac.
- (5) Input Adaptor. See Figure 7.
- (6) 1K resistors.
- (7) Dynamco 71 Series X Module.
- (8) Dynamco 71 Series Y Module 1Y2.
- (9) 1:1 Module to Display Unit extension leads (Dynamco 7148).
- (10) Constant Amplitude Sinewave Generator; frequency variable from 50KHz to 100MHz, e.g. Tektronix 191.
- (11) Time Marker Generator producing sinewave or pulse from 1s to 20ns $\pm$ 1%, e.g. Tektronix 184.
- (12) BNC T-junction, e.g. Greenpar Eng. Co. GE35031.
- (13) Trimming tool.
- (14) Pulse generator capable of producing square waves in the range 300KHz to 1.25MHz nominal, amplitude 50mV to 500mV terminated. Rise times to be not greater than 4ns, perturbations on pulse not greater than 2%, e.g. Cossor Model 1090.

Preliminary Checks

With the multimeter (item 1) negative lead connected to the chassis, measure the resistance of all power rails. Expected resistance values are given in Table 6. A tolerance of $\pm 25\%$ is permissible.

TABLE 6. POWER RAIL RESISTANCE

Power Rail	Location	Approximate Resistance
+117V rail	pin 1 XSKTA	2.5K
+ 63V rail	9 on PC1	2K
+ 30V rail	3 XSKTA	3.8K
+ 20V rail	4 XSKTA	1.6K
+ 15V rail	5 XSKTA	630 ohms
0V rail	6 XSKTA	0 ohms
- 15V rail	9 XSKTA	670 ohms
6.3V a.c.	7 & 8 XSKTA	<0.3 ohms

Power Supplies

- (1) Plug in the Y dummy load (item 2) and using the digital voltmeter (item 3) check the voltage of the supply rails with the main frame powered via the variac (item 4) set to give 234V. The tolerance of each supply is given in Table 7. Verify that the ripple conforms to the limit given in column 3.

TABLE 7. POWER SUPPLY TOLERANCES

Rail	DC Voltage Tolerance	Ripple 100Hz p/p	Stabilization
-15V set 3RV1	$\pm 20\text{mV}$	$\nabla 2\text{mV}$	10mV dc p/p
+15V	$\pm 0.3\text{V}$	$\nabla 5\text{mV}$	50mV dc p/p
+20V) unreg.	+5V -0V	$\nabla 1.0\text{V}$	
+30V)	$\pm 2.5\text{V}$	$\nabla 1.0\text{V}$	
+63V	$\pm 2\text{V}$	$\nabla 250\text{mV}$	1.5V
+117V	$\pm 0.5\text{V}$	$\nabla 2\text{mV}$	500mV

- (2) Using the pin numbers given in Table 6, check that the supplies are present on the X side. To check the stabilisation of the supplies, use the variac to vary the power input between -7% and +10% (220V to 247V). The results should be as shown in Table 7, column 4.

Tube Electrode Potentials

- (1) Switch off the instrument and turn the BRILL control fully counter-clockwise.
- (2) Locate and open the EHT box (see section 5.1).
- (3) Set the digital voltmeter to 2000V range and monitoring at c.r.t. base pin 2 switch on. After warm-up period of two minutes, set 4RV1 for $957\text{V} \pm 5\text{V}$.
- (4) Switch off the instrument, disconnect the digital voltmeter and replace the EHT box cover.
- (5) Switch on, set the BRILL control midway, and then set 3RV80 so that the c.r.t. spot is just visible.

Calibrator

Remove the calibrator screen and remove transistor 1VT50 from its socket. With the digital voltmeter connected to the probe link on the front panel of the display unit, set 1RV51 for a reading of $5\text{V} \pm 0.02\text{V}$. Check at the relevant sockets for $50\text{mV} \pm 1\text{mV}$ and $500\text{mV} \pm 10\text{mV}$. Replace 1VT50.

X Amplifier Bias

- (1) Plug the input adaptor (item 5) into the X side of the display unit.
- (2) Using the crocodile clip, short the X input to chassis.
- (3) Switch on and with the multimeter (item 1) connected by 1K 'stopper' resistors (item 6) to the pins of the X plates, adjust 2RV4 for equal voltages on each pin to within $\pm 1\text{V}$.
- (4) Adjust 2RV2 for an X plate potential of $52 \pm 1\text{V}$ w.r.t. chassis.
- (5) Re-adjust 2RV4 so that the spot is on the centre graticule line.

X Amplifier Gain

Feed the 500mV calibrator signal into the X amplifier input (UHF socket of adaptor). Set 2RV1 for 2.5 graticule divisions between spots.

Y Amplifier Balance

Plug in adaptor (item 5) and short circuit input. Adjust 1RV4 so that the spot is on the centre horizontal graticule line. Using the multimeter with 1K 'stopper' resistors in series with the leads, check that the voltage w.r.t. chassis on each Y plate is $43V \pm 2V$.

Y Amplifier Gain

Feed a signal of 500mV from the calibrator via the UHF socket of the input adaptor into the Y amplifier. Set 1RV1 for 2.5 graticule divisions between spots.

Gun Alignment

If a MOV tube is in use, defocus and set 3RV61 for minimum edge shadow.

Trace Alignment

- (1) Plug on an X module and connect a Y module via an extension lead (item 9) to the display unit.
- (2) Set the X and Y module controls so that the trace is visible across the centre of the tube.
- (3) Adjust 2RV50* so that the trace is parallel with a horizontal graticule line. If necessary reverse the connections to pins 64 on the X amplifier card.
- (4) Using the signal generator (item 10), feed 50KHz into a Y channel.
- (5) Set the TIME/DIV control on the X module to 1ms.
- (6) Adjust X SET CAL for ten divisions of time base and adjust the output of the signal generator and the Y sensitivity to obtain six divisions of vertical deflection. This will give a rectangle of light measuring 10x6 divisions. Adjust 3RV62 for the most rectangular display.

Calibrator Frequency Setting

To set the frequency of the calibrator it is necessary to compare the 5V calibrator signal with a known frequency standard (item 11). Three comparison methods are suggested; in all cases the calibrator frequency is adjusted by means of 1RV50.

- (1) Apply the calibrator signal to the X input and the standard to the Y input and compare the frequency by means of Lissajous figures.
- (2) Sum the calibrator and standard signals in a resistor and adjust the calibrator frequency until the marker pips coincide with the calibrator square wave.

* On later models this is a front panel control, located under the handle.

- (3) Set the X module TIME/DIV control using the standard frequency source. Apply the calibrator signal and adjust the calibrator frequency so that the trace occupies the same divisions per cycle as the standard.

Scanning Direction and Y Deflection Direction

Check that the spot scans from left to right and use the calibrator to check that the trace moves up for positive signals.

X Amplifier H.F. Linearity

- (1) Apply a 50MHz sine wave from the time mark generator (item 11) to the channel 1 input on the 1Y2, and adjust for a display of about 1 division peak to peak.
- (2) Set the X module controls as follows :-

TIME/DIV	:	0.2 μ s
INT/EXT/EXT $\div$ 20	:	INT
D.C. EXT/AC/ACF	:	AC
SYNC / + / -	:	SYNC
PULL X10	:	out
H.F. STAB	:	)
LEVEL	:	) adjust for locked display
SHIFT	:	centralize display
- (3) Adjust 2C8 for optimum linearity and time calibration. The error from the first to the 10th graticule division should not exceed 0.5 division.

Bright-Up Check

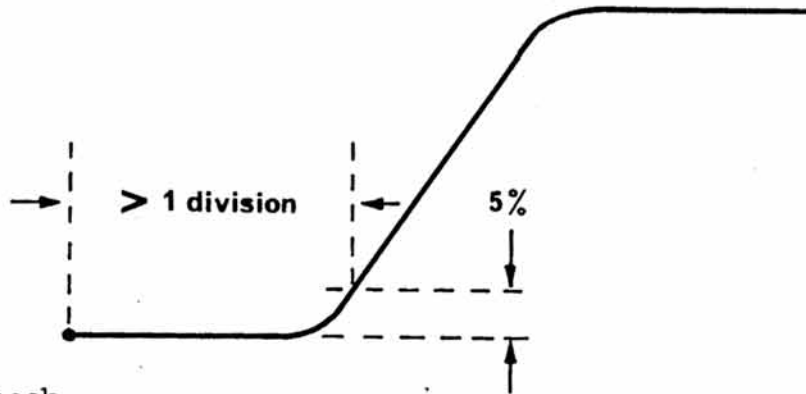
- (1) Connect the channel 1 input on the 1Y2 via a 10:1 probe to the junction of 6R15 and 6R17. Connect the earth lead on the probe to pin 7 of PC6 (i.e. the bright-up board).
- (2) Set the X module controls as follows :-

TIME/DIV	:	0.2 μ s
H.F. STAB	:	AUTO
SYNC / + / -	:	SYNC
LEVEL	:	Fully counter-clockwise
INT/EXT/EXT $\div$ 20	:	EXT
- (3) Adjust 6C1 for a square front corner on the display. If this cannot be done, remove 6C16 and re-adjust 6C1. Disconnect the probe.
- (4) Connect the output of the pulse generator (item 14) to the channel 1 input on the 1Y2. Adjust the pulse generator and Y1 controls to obtain a signal about 4 divisions high.
- (5) Set the X module controls as follows :-

TIME/DIV	:	0.2 μ s
INT/EXT/EXT $\div$ 20	:	INT
DC EXT/AC/ACF	:	AC

SYNC / + / -	:	+
PULL X10	:	out
H.F. STAB	:	AUTO

- (6) Adjust the X shift control to display the leading edge. Adjust the LEVEL control for maximum trace length between the start of the trace and the positive edge. Verify that the display conforms to the diagram below at normal brilliance.



Blanking Check

- (1) Set the 1Y2 mode switch to CHOP and adjust the channel 1 and channel 2 shift controls for a trace separation of about 4 divisions.
- (2) Connect the DISPLAY OUT socket at the rear of the Y module to the EXT TRIG input on the X module.
- (3) Set the X module controls as follows :-

TIME/DIV	:	10 μ s
INT/EXT/EXT $\div$ 20	:	EXT
DC EXT/AC/ACF	:	AC
SYNC / + / -	:	+
- (4) Adjust the LEVEL control to display chopped traces at normal brilliance. Verify that the transitions between channels are adequately blanked.
- (5) Set the TIME/DIV switch to 5 μ s, the mode switch on the Y module to Y1 and disconnect the DISPLAY OUT socket from the EXT TRIG input.
- (6) Connect the output of the sinewave generator (item 10) to the EXT TRIG input on the X module and the Z MOD socket on the rear of the display unit, using the T-junction (item 12).
- (7) Set the sinewave generator to give a 50KHz output, 5V amplitude peak to peak. Verify that at normal brilliance the trace is noticeably blanked at 50KHz.

Y Amplifier Response Check

- (1) Remove the Y module and connect the adaptor (item 5) to SKTC. Connect the output of the pulse generator (item 14) to the input of the adaptor. Connect the trigger output of the pulse generator to the EXT TRIG input on the X module. Set the pulse generator to maximum output and nominal mid-frequency.

- (2) Set the X module controls as follows :-

TIME/DIV	:	0.2 μ s
INT/EXT/EXT + 20	:	EXT
DC EXT/AC/ACF	:	AC
SYNC / + / -	:	+
PULL X10	:	out

- (3) Set the LEVEL control midway and adjust the X shift control to display the leading edge (re-adjust the pulse generator frequency if necessary).
- (4) Set 1RV3 and 1RV2 fully clockwise.
- (5) Adjust 1C1, 1C2 and 1C3 for maximum ring.
- (6) Adjust 1RV3 until primary ring just stops.
- (7) Adjust 1C1 for a flat top to the pulse.
- (8) Re-adjust 1RV3 until the primary ring just stops.
- (9) Adjust 1RV2, 1C2 and 1C3 for the squarest corner.
- (10) Re-adjust 1RV3, 1C1, 1C2, 1RV2 and 1C3 for the best combination of flat top and fast rise time.
- (11) Return the PULL X10 control to the X1 position, and check the display for optimum squareness and minimum mean perturbations (± 1 line width).
- (12) Repeat the above as necessary to obtain best compromise.

Bandwidth Check

- (1) Ensure that the adaptor (item 5) is connected to SKTC. Connect the output of sinewave generator (item 10) to the adaptor input.
- (2) Set the sinewave generator to 50KHz and adjust the amplitude to give a display 5 divisions high.
- (3) Increase the frequency until the display decreases in height to 3.5 divisions.
- (4) Verify that the frequency is not less than 65MHz (typically 75MHz).

Internal Link Continuity Check

Verify using the multimeter (item 1) that continuity exists between the following pins :-

SKTB/7	and	SKTC/7
SKTB/6	and	SKTC/6
SKTB/11	and	SKTC/11
SKTB/12	and	SKTC/12

5.3 MAINTENANCE BY DYNAMCO

If an instrument is returned to Dynamco Limited for repair or recalibration, please state clearly what is wrong. Do not return any cable unless it is suspect, in which case please note this on the documents accompanying the instrument, and under no circumstances return any handbooks.

6. PARTS LIST

6.1 GENERAL

The following list includes all replacement parts. When ordering, please quote the NAME, TYPE and SERIAL NUMBER of the instrument, together with the CIRCUIT REFERENCE of the part and the relevant SUB-ASSEMBLY.

DMS numbers given for semi-conductor components refer to standards defined by Dynamco Limited to ensure that only those equivalent components are used which enable the specified performance of the instrument to be achieved.

6.2 CHASSIS COMPONENTS

<u>Circuit</u>	<u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RESISTORS						
R1		100K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R2		100	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
VARIABLE RESISTORS						
RV1		50			Ganged with SB	A.B. Metals
CAPACITORS						
C1		3300p		160V		Waycom
C2		0.1	±20%	250V	Foil	Mullard C280AE/P100K
TRANSISTORS						
VT1 to VT5						DMS 89
MISCELLANEOUS						
FS1		Fuse, slow blow: 500mA (200-250V)				Beswick IDC 134
				1A (100-125V)		Beswick TDC 134
ILP1,2		Lamp, graticule	6.3V	1W	LES	
ILP3		Lamp, power	110V			Thorn SGF9A/RED/110V
PL1		Connector, power, 3-pole				Bulgin P429
SA		Switch, HIGH/LOW				Oak 278
SB		Switch, on/off, ganged with RV1				
SKTA to SKTD		Socket, fixed, 12 pole				McMurdo XS 12
SKTE to SKTH		Socket, fixed, 4mm				Belling and Lee L1413
T1		Transformer			Dynamco B 108 0218	
T2		Transformer			Dynamco A 108 0129	

Circuit Ref.	Value	Tol.	Rating	Type	Style
V1	Cathode Ray Tube			Thorn AEI P2	D13-51GL *
				P7	D13-51GM*
				P11	D13-51BE *
				P31	D13-51GH *

* Suffix 26 denotes internal graticule.

6.3 Y AMPLIFIER AND CALIBRATOR

NOTE: All components on this board are prefixed "1" on the circuit diagram (Fig. 8).

Complete printed circuit board assembly

Dynamco 105 0186/3

RESISTORS

R1	1.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R2	1.0K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R3	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R4	180	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R5	1.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R6	68	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R7	68	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R8	1.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R9	1.0K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R10	1.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R11	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R12	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R13	180	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R14	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R15	470	±5%	3W	Wirewound, vitreous	
R16	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R17	68	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R18	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R19	470	±5%	3W	Wirewound, vitreous	
R20	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R21	68	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R22	68	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R23	430	±5%	3W	Metal oxide	Welwyn Metox F32P
R24	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R25	430	±5%	3W	Metal oxide	Welwyn Metox F32P
R26	68	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R27	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R28	22	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R29, 30	1.8K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R31, 32	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R33	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R34	8.2K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R35	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R50	2.2K	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R51	1.2K	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R52	470	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114

Circuit Ref.	Value	Tol.	Rating	Type	Style
R53, 54	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R55, 56	470	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R57	900	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R58	450	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R59	45	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R60	5	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R61	45	±1%	$\frac{1}{4}$ W	HS, Spiral carbon	Welwyn C2114
R62	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT

VARIABLE RESISTORS

RV1	220			Linear	Morganite 62H
RV2	1K			Linear	Morganite 62H
RV3	100			Linear	Morganite 62H
RV4	500			Linear	Morganite 62H
RV50, 51	220			Linear	Davall 80P

CAPACITORS

C1	2-60p			Foil dielectric trimmer	Mullard C01DA A/60E
C2	7-35p			Variable, ceramic	Steatite TRIKO 7S
C3	7-35p			Variable, ceramic	Steatite TRIKO 02
C4 to C6	0.1	±20%	250V	Min.met.foil	Mullard C280AE/P100K
C7	2200p	±2%	400V	Film and foil	Wima Tropyfol F
C8	0.1	±2%	160V	Metallised film	Wima Tropyfol M
C9, 10	20		16V	Electrolytic	Mullard C426 AR
C11, 12	100p	±10%	400V	Film and foil	Wima Tropyfol F
C50	1	±1%	160V	Metallised film	Wima Tropyfol M
C51	0.1	±20%	250V	Min.met.foil	Mullard C280AE/P100K
C52	470p	±10%	400V	Film and foil	Wima Tropyfol F

TRANSISTORS

VT1					DMS 93
VT2, 3					DMS 79
VT4 to VT6					DMS 93
VT50, 51				(Calibrator)	DMS 93
VT52				(Calibrator)	DMS 84

MISCELLANEOUS

Socket, transistor	Magnetic Devices
	Elco 05-3303
Pin, formed, 0.058 in. dia.	Amp 60809-1

6.4 X AMPLIFIER

NOTE: All components on this board are prefixed "2" on the circuit diagram (Fig. 8).

Complete printed circuit board assembly

Dynamco 105 0185/13

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RESISTORS					
R1	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R2	560	±2%	$\frac{1}{4}$ W	H.S.	Electrosil TR5
R3, 4	160	±2%	$\frac{1}{2}$ W	H.S.	Electrosil TR6
R5	560	±2%	$\frac{1}{4}$ W	H.S.	Electrosil TR5
R6, 7	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R8	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R9	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R10 to R12	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R13	1K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R14, 15	22	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R16	1K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R17	220K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R18	2.2K	±5%	3W	Metal oxide	Welwyn F75
R19	22	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R20	2.2K	±5%	3W	Metal oxide	Welwyn F75
R21	220K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R22, 23	33	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R24	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R25	1K	±2%	$\frac{1}{4}$ W	H.S.	Electrosil TR5
R26	390	±10%	$\frac{1}{2}$ W	Composition	
R50	82	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
VARIABLE RESISTORS					
RV1	100			Linear	Davall 80P
RV2	470			Linear	Davall 80P
RV4	470			Linear	Davall 80P
RV50	1K			SD, linear	Reliance MW
CAPACITORS					
C2 to C4	0.1	±20%	250V	Min. foil	Mullard C280AE/P100K
C6, 7	0.01	±20%	250V	Min. foil	Mullard C280AE/P10K
C8	2-60p			Foil dielectric trimmer	Mullard C010AA/60E
C50	1000		25V	Electrolytic	Plessey CE1205
DIODES					
D1, 2				Zener	DMS 127
TRANSISTORS					
VT1					DMS 93
VT2, 3					DMS 80
VT4					DMS 93
VT5, 6					DMS 84
MISCELLANEOUS					
L1	Choke - 50μH				Painton 200 509
	Socket, transistor				Magnetic Devices
	Pin, formed, 0.058 in. dia.				Elco 05-3303
					Amp. 60809-1

Circuit	Value	Tol.	Rating	Type	Style
Ref.					

6.5 POWER SUPPLY CARD

NOTE: All components on this board are prefixed "3" on the circuit diagram (Fig. 8).

Complete Card Assembly

Dynamco 105 0183/3

R1	1.2K			Metal oxide	Welwyn F75
R2	5.6K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R3	8.2K			Metal oxide	Welwyn F75
R4	22K	±2%	$\frac{1}{2}$ W	H.S.	Electrosil TR6
R5	560	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R6	330	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R7	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R8	1K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R9	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R10, 11	3.3K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R12	3.14K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R13	2.86K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R14	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R15	10K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R16, 17	15K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R18	47K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R19	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R20	100	±5%	3W	Wirewound, vitreous	
R21	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R22	100K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R23	10K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R24	1M	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R25	10	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R26	5.6K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R27	1K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R28	220	±5%	3W	Wirewound, vitreous	
R45	390K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R46	330K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R47	470K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R48	430K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	Welwyn C2114
R49	4.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R50	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R60	68K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R61	39K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R62	10K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R63	47K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R80, 81	2.2M	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R82	2.7M	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R83	220	±2%	$\frac{1}{4}$ W	Composition	LCA 0309

VARIABLE RESISTORS

RV1	1K	Linear	Davall 80P
RV2	4.7K	Linear	Davall 80P

<u>Circuit</u> <u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RV40	1M			Linear	Morganite UFMF
RV60	50K			Linear	Morganite UFMF
RV61, 62	47K			Linear	Davall 80P
RV80	1M			Linear	Morganite UFMF
RV81	1M			Linear	Davall 80P
CAPACITORS					
C1	100		275V	Electrolytic	CCL PN51S
C2	50+50		150V	Electrolytic	CCL PK53S
C3	5000		25V	Electrolytic	CCL EE53S
C4	4000		25V	Electrolytic	CCL EE75DS
C5	50+50		150V	Electrolytic	CCL PK53S
C6, 7	80		25V	Electrolytic	Mullard C426CB
C8	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C9	1	±10%	160V	Metallised film	Wima Tropyfol 'M'
C10	2500		40V	Electrolytic	CCL EG106DS
C11	0.1	±20%	250V	Min. met. foil	Mullard C280AE/P100K
C40	0.03		1.5KV		Erie CP5
C41	0.02	±20%	250V	Min. met. foil	Mullard C280AE/P22K
DIODES					
D1 to D7					DMS 116
D8 to D19					DMS 135
D20, 21					DMS 92
D22				Zener	DMS 129
D23				Zener	DMS 132
D24				Zener	DMS 126
D25				Zener	DMS 46
D26				Zener	DMS 130
D27					DMS 116
D60				Zener	DMS 128
D62, 63					DMS 92
TRANSISTORS					
VT1 to VT7					DMS 82
MISCELLANEOUS					
	Socket, transistor				Magnetic Devices
					Elco 05-3303
	Pin, formed, 0.058 in. dia.				Amp. 60809-1

6.6 EHT REGULATOR CARD

NOTE: All components on this board are prefixed "4" on the circuit diagram (Fig. 8).

Complete Card Assembly

Dynamco 105 0182/3

<u>Circuit Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
RESISTORS					
R1	56K	±2%	$\frac{1}{2}$ W	Composition	Electrosil TR6
R2	10K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R3	180	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R4	33	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R5	3.3	±5%	3W	Wirewound, vitreous	
R6	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R7	220K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R8	120K	±1%	$\frac{1}{4}$ W	Spiral, carbon, H.S.	

VARIABLE RESISTORS

RV1	100K			Linear	Davall 80P
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CAPACITORS

C1	500p		6KV	Ceramic	Centralab DD60-501
C2, 3	1000p	±10%	400V	Foil and film	Wima Tropyfol F

DIODES

D1 to D3					DMS 92
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TRANSISTORS

VT1					DMS 81
VT2					DMS 82

MISCELLANEOUS

Socket, transistor					Magnetic Devices Elco 05-3303
Pin, formed, 0.058 in. dia.					Amp. 60809-1

6.7 EHT RECTIFIER CARD

NOTE: All components on this board are prefixed "5" on the circuit diagram (Fig. 8).

Complete Card Assembly					Dynamco 105 0181/3
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RESISTORS

R1	2.2M	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R2	10K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT

CAPACITORS

C1	0.02		4KV	High voltage	Erie CP4
C2 to C4	500p		6KV	High voltage	Centralab DD60-50
C5 to C7	0.02		4KV	High voltage	Erie CP4

DIODES

D1 to D4					DMS 91
D5				Zener	DMS 132
D6					DMS 91

<u>Circuit</u>	<u>Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
MISCELLANEOUS						
		Pin, formed, 0.058 in. dia.				Amp. 60809-1

6.8 BRIGHT UP CARD

NOTE: All components on this board are prefixed "6" on the circuit diagram (Fig. 8).

Complete Card Assembly Dynamco 105 0184/3

RESISTORS

R1	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R2	10K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R3	47	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R4	390	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R5	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R6	470	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R7	68	±10%	RW	Composition	Dubilier BTT
R8	22	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R9	4.7K	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R10	68	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R11	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R12	15	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R13, 14	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R15	33	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R16	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R17	120	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R18	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R19	10K	±2%	RW	Composition	LCA 0309
R20	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R21	470	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R22	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R23	47K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R24	47	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R25	1M	±2%	$\frac{1}{4}$ W	Composition	LCA 0309
R26	100	±10%	$\frac{1}{4}$ W	Composition	Dubilier BTT
R27	3.3K	±2%	$\frac{1}{4}$ W	Composition	LCA 0309

CAPACITORS

C1	2-60p			Foil, dielectric, trimmer	Mullard C010AA/60E
C2	180p	±10%	400V		Wima Tropyfol 'F'
C3	0.1		250V	Min. met. foil	Mullard C280AE/P100K
C4	0.47	±10%	160V		Wima Tropyfol 'M'
C5	0.01		250V	Min. met. foil	Mullard C280AE/P10K
C6	150p	±10%	400V		Wima Tropyfol 'F'
C7 to C10	0.1		250V	Min. met. foil	Mullard C280AE/P100K
C11	4700p	±2%	160V		Wima Tropyfol 'F'
C12	80		25V	Electrolytic	Mullard C426 CB

<u>Circuit Ref.</u>	<u>Value</u>	<u>Tol.</u>	<u>Rating</u>	<u>Type</u>	<u>Style</u>
C13	470p	±10%	400V		Wima Tropyfol 'F'
C14	0.03		1.5KV	Ceramic	Erie CP5
C15	0.1		250V	Min.met.foil	Mullard C280AE/P100K
C16	27p	±10%	750V	Ceramic	Lemco CT316/NPO 1/R27P
C17	0.1		250V	Min.met.foil	Mullard C280AE/P100K

DIODES

D1					DMS 92
D2					DMS 90
D3				Zener	DMS 131
D4					DMS 92

TRANSISTORS

VT1, 2					DMS 81
VT3, 4					DMS 88
VT5					DMS 93
VT6					DMS 88

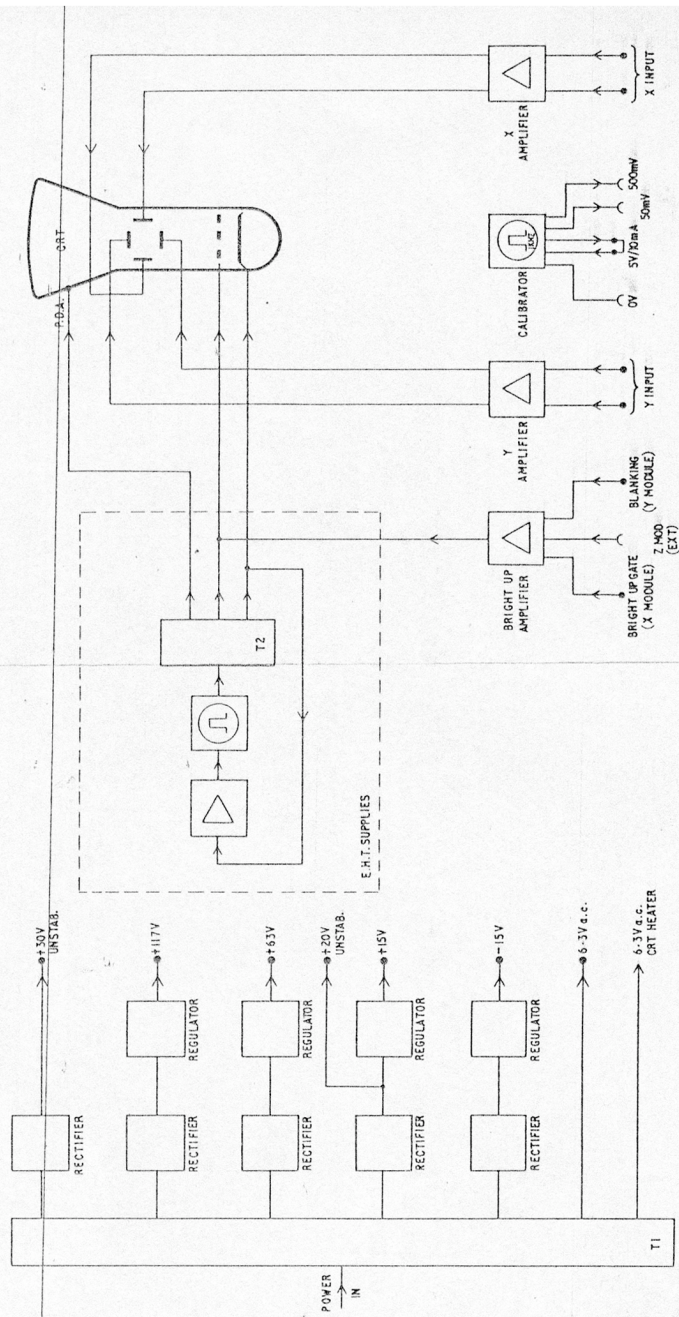
MISCELLANEOUS

L1	Inductor - 100μH				Painton 205 11 or 58-10-0017-10
	Socket, transistor				Elco 05-3303
	Pin, formed, 0.058 in. dia.				Amp. 60809-1

6.9 ACCESSORIES (OPTIONAL)

<u>Description</u>	<u>Type</u>
Rack Mounting Kit (71 Series)	7151
Blank Plug-On Unit (X or Y); Width 3.75 in. (9.53 cm)	7141/1
Width 2.75 in. (7 cm)	7141/2
Width 2 in. (5.08 cm)	7141/3
Viewing Hood	7142
Oscilloscope Trolley	7143
Oscilloscope Muff (71 Series)	7144
Passive Probe Kit 'A' with 10:1 and 1:1 Attenuators	7145
Passive Probe Kit 'B', as 7145 but with:-	7146
Signal lead BNC to BNC (36 in.)	
Signal lead BNC to 4mm plugs with clips (36 in.)	
BNC to terminal adaptor with earth	
Signal lead BNC to 4mm plugs with crocodile clips (36 in.)	7147

NOTE: Unless otherwise stated, signal leads with BNC plugs will be made of 50 ohm coaxial cable.



DISPLAY UNIT 7100—BLOCK DIAGRAM FIG.5

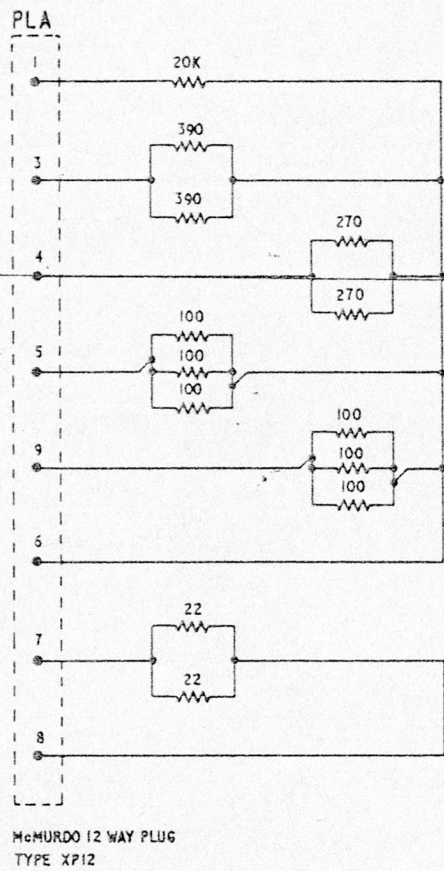


FIG.6 DUMMY LOAD

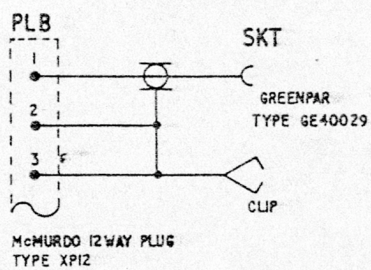
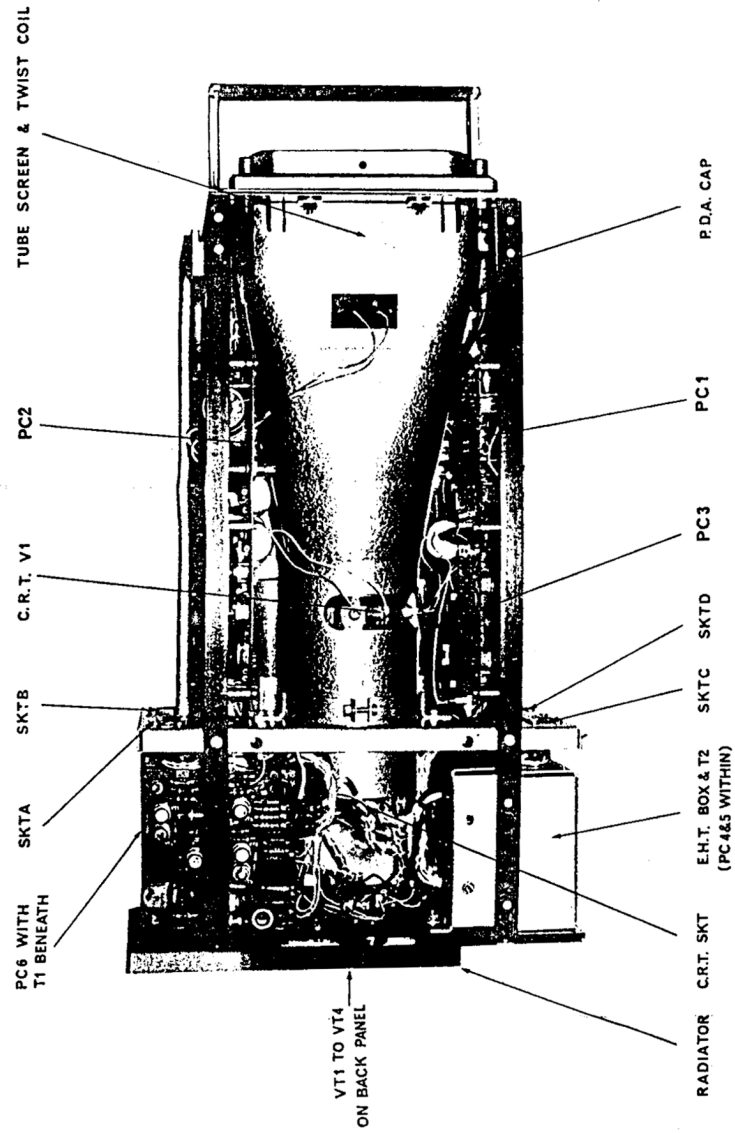
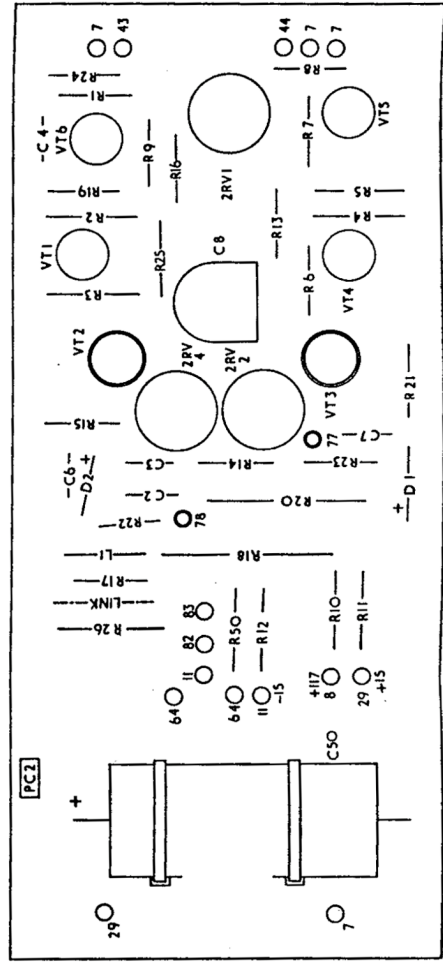
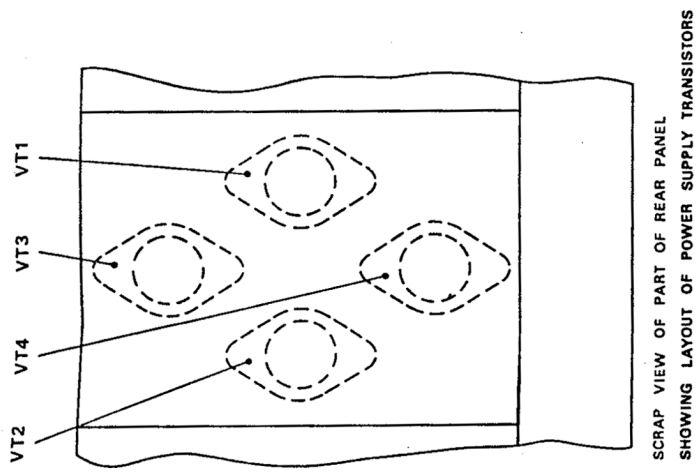


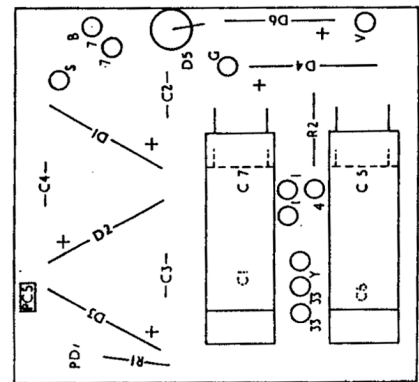
FIG.7 INPUT ADAPTOR



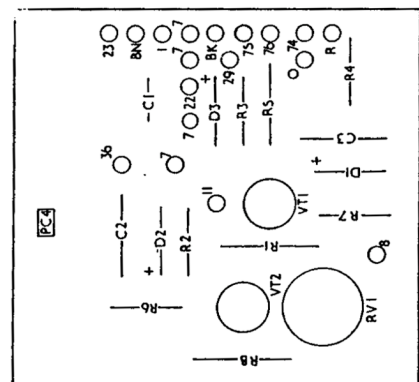
CHASSIS LAYOUT



X AMPLIFIER BOARD

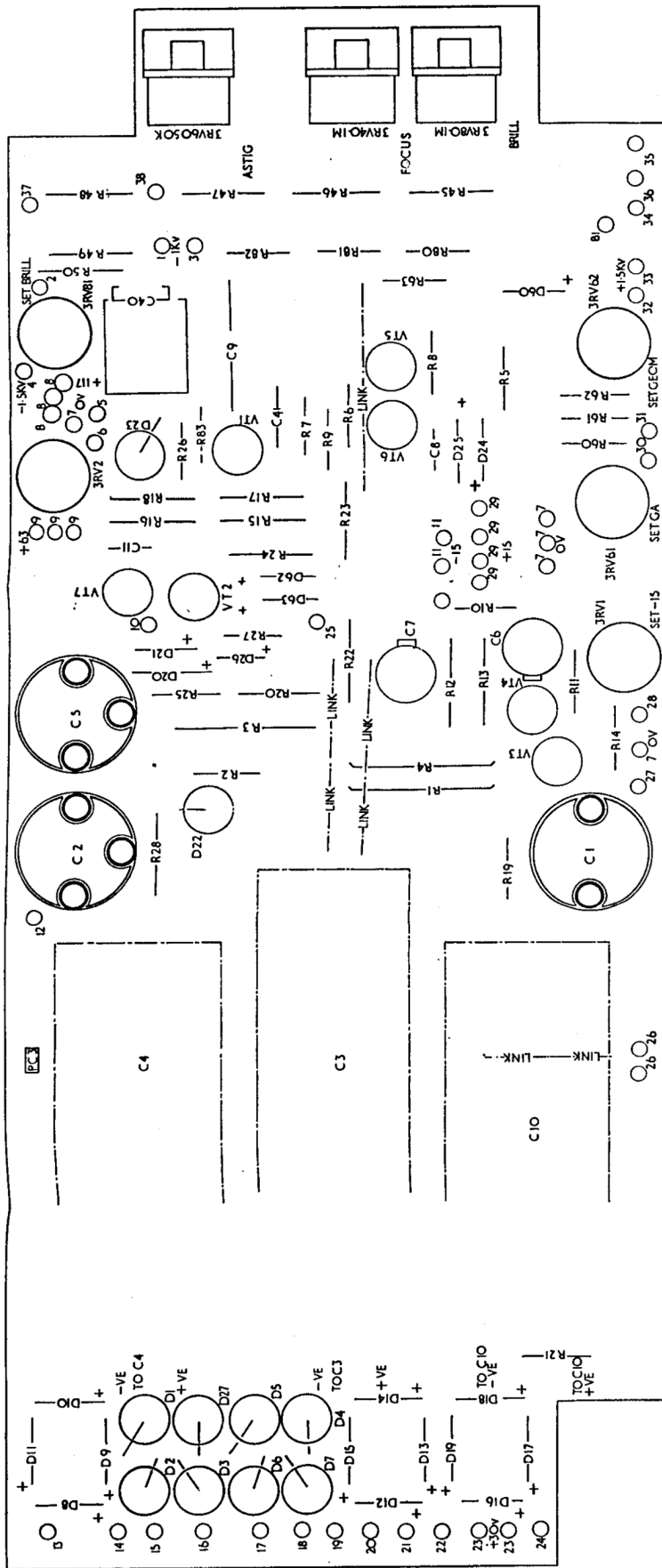


EHT RECTIFIER BOARD

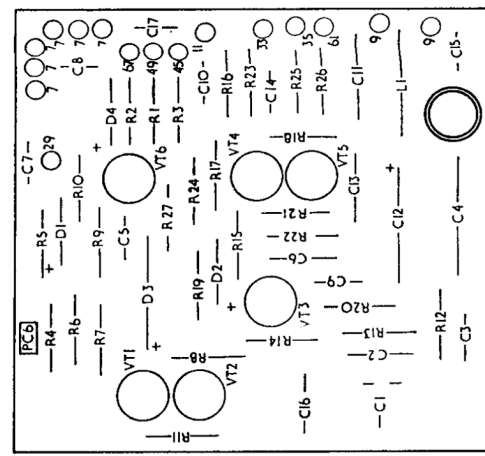


EHT REGULATOR BOARD

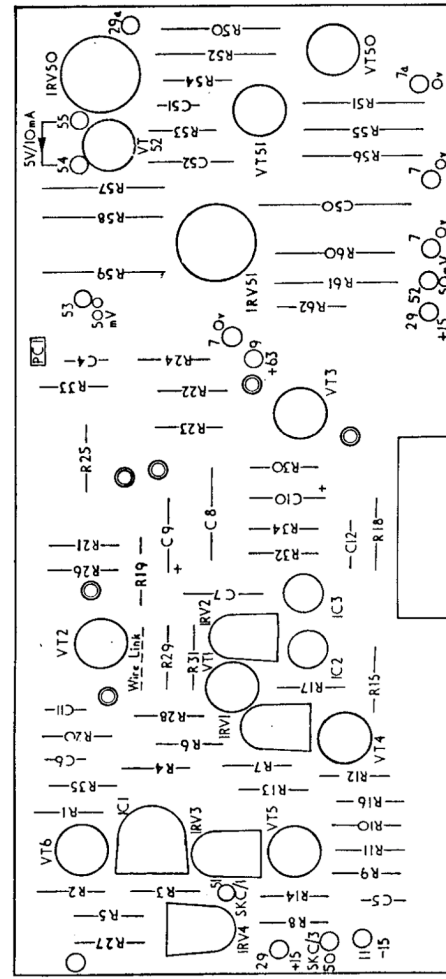
FIG.9 COMPONENT LOCATION



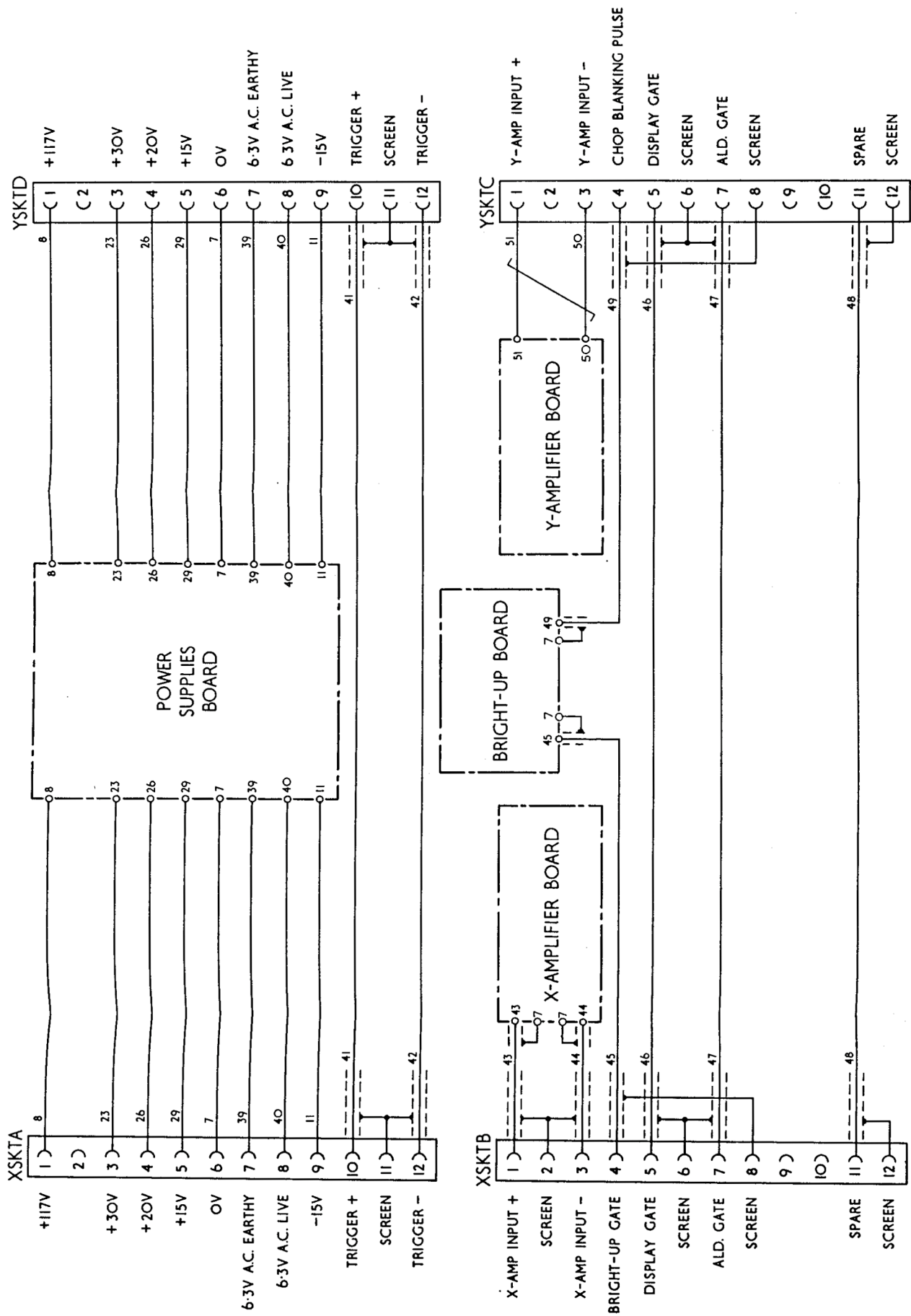
POWER SUPPLIES BOARD



BRIGHT UP BOARD



Y AMPLIFIER AND CALIBRATOR BOARD



CHASSIS INTERCONNECTIONS FIG.11